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The Forester

A GERMAN SPRUCE FOREST.

A monthly magazine, devoted to the care and use of forests and forest trees, and related subjects.

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THE AMERICAN FORESTRY ASSOCIATION.

ORGANIZED APRIL, 1882.

INCORPORATED JANUARY, 1897.

The object of this Association is to promote:

1. A more rational and conservative treatment of the forest resources of this continent.
2. The advancement of educational, legislative and other measures tending to promote this object.
3. The diffusion of knowledge regarding the conservation, management and renewal of forests, the methods of reforestation of waste lands, the proper utilization of forest products, the planting of trees for ornament, and cognate subjects of arboriculture.

Owners of timber and woodlands are particularly invited to join the Association, as well as are all persons who are in sympathy with the objects herein set forth.

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Our Spruce Supplies.

The American Paper and Pulp Association, at its annual meeting on February 16, devoted one whole session to the discussion of forestry matters. This may be considered one of the most promising signs of a practical awakening of business interests to the needs of a change of policy. We devote, therefore, a large part of this issue to the consideration of our wood-pulp supplies and their treatment, printing abstracts of the papers read at that meeting.

The wood-pulp interests are mainly centered in our Spruce forests. Although other species can be and are used for the production of both ground pulp and chemical fiber, the proportion of such other species, as Pine, Hemlock, Cypress, Fir and Tamarack of conifers, and Poplar, Basswood, Cottonwood, Maple, Gum and Buckeye of broad-leaved trees, is very small.

We have no doubt that as the supplies of the more desirable species, Spruce, give out, the less desirable, those more difficult of treatment, will be used, and the paper will correspondingly become poorer and dearer. Of late the paper industry has suffered as much or perhaps more than other industries by unprofitable prices, due to overproduction; and the application of forestry principles to the management of their woodlands, which means always expense—curtailment of present profits—for the sake of increased future revenue, may not come as soon as the newly awakened interest would seem to promise. There is, however, one hope to be found in the fact that a syndicate has been formed which we understand will control 80 per cent, more or less, of the mill capacity To such a combination alone we may look for improvement in the handling of the woodlands. When the margin of the pulp business becomes more comfortable, which may be expected as a re-

sult of such control of production and market, then we may see forestry methods first applied in the Spruce forests, a beginning of which is already being made. The expected action of the State of New York in placing 30,000 acres of Adirondack lands, which means Spruce forest in part, under management of the Cornell University, may perhaps contribute toward such a result by placing an example before the woodland owners.

We have in the United States seven distinct species of Spruce (*Picea*), of which four, at least, occur in more or less large large bodies. Four of the seven belong to the Western parts of the country, the Rocky Mountains and Pacific Coast. Of the three Eastern species, one, *Picea rubra*, is rare, and has only lately, even botanically, been differentiated, while the other two, the White and Black Spruce (*Picea canadensis* and *mariana*) (the distinction made by the logger refers to character of wood and not to botanical species rarely or not at all distinguished by the logger) occupy in mixture a very large territory. They are with the Aspen the most northern trees, extending their realm to the tundras themselves and cross the continent on their northern line from Newfoundland and Labrador to the Mackenzie River and Alaska. They are essentially trees of cool situations, long winters and short summers, and are found in largest quantities in Canada, although individual development is better in some parts of the United States.

In the States the Black Hills represent the most western extension, with considerable amounts of White Spruce on the northern cooler slopes.

While the Black Spruce finds its way southward along the Alleghenies on the higher elevations, even to the high peaks of North Carolina, commercial quantities are found only on limited areas in Maine, New Hampshire and the Adirondacks in New York. The amount of Spruce in Pennsylvania, Michigan and Wisconsin is quite small and scattered.

We can safely estimate the area within which Spruce in the East occurs in mercantile condition as less than twenty million acres. It occurs in this area occasionally as pure growths, but mostly as an admixture, in groups or single trees, of a hardwood forest of Birch and Maple, and mostly on soils which offer no advantages for agricultural use Being able to support a very considerable amount of shade and being a prolific seeder, there is even less danger of its extirpation than of the White Pine in spite of the worst treatment. It is a species that responds most gratefully to any small attention which man may bestow upon it. Although the European or so-called Norway Spruce is a different species (*Picea excelsa*), the general biological characteristics are the same, and hence the sylvicultural treatment of our Spruce forests should be similar. Our species lend themselves specially to methods of natural regeneration —*i. e.*, those in which, by mere rational use of the ax, reproduction is secured. Since the usefulness of Spruce is infinitely greater than that of the hardwoods that accompany it, the management for reproduction should tend toward creating as much as possible pure Spruce forest, or at least to reduce the admixtures of broad-leaved trees to a smaller proportion, when their protective influence, especially against windfalls, to which the Spruce, with its shallow-root system, is exposed, may be advantageous. The

present methods of cutting out the Spruce to smallest diameter have the very opposite result.

Our illustration on the cover represents a typical German Spruce forest, 60 to 80 years old, ready for the ax, with not less than 400 trees and 12,000 cubic feet of solid wood to the acre, such as we expect to see in our country as a result of forestry practice in the Adirondacks and New England pulp-wood districts.

News and Editorial Comment.

The Forestry Congress, which was to be held at Tampa, Fla., on February 22, under the auspices of the American Forestry Association, did not take place, because some of the speakers who were expected to make the occasion a success were prevented by other engagements to appear It was therefore deemed wiser to postpone such a winter meeting until next season.

Meanwhile the Association has received invitations to hold summer meetings in California under the auspices of the Yosemite Valley Commission and the Sierra Club, at Omaha, Neb., in connection with the Exposition, and at Boston in connection with the American Association for the Advancement of Science, and it is contemplated to accept all three invitations, and to hold meetings in the three widely separated places, with the expectation that the local membership and the local interests will make the meetings successful.

We congratulate the State of New York upon the excellent showing which the Forest Preserve Board has made in its first annual report, from which we learn that by an expenditure of $940,401 the State has increased its holdings to the extent of over 250,000 acres. The expenses of the purchase being $18,700, or less than 2 per cent, and the price per acre ranging from $1.50 to $7, figures $3.68½ on the average, a reasonable enough price under the circumstances.

The manner of appraising the land appears eminently just and business-like, and it is doubtful whether the average price could have been materially lowered by any method of delay and barter. That individual cases should arise where lower prices, presumably at least, might have been secured is unquestionable, and can never entirely be eliminated from any kind of large transactions; but there seems nothing in these transactions which would justify general attacks, in which a good work is reviled without a single specific charge. This great purchase should serve as a hint to other States, particularly those of the Lake region, to secure their forest land while it may still be easily and cheaply acquired.

The report of the Board, embodying essential parts of the Governor's message, the act under which the Board works, the considerations which have led it, and a detailed showing of its purchases, is a thoroughly business-like statement which we would recommend every legislator in the country to read in order to learn how to look at the matter of forest conservancy.

"The money invested by the State of New York in the purchase of their forests is an asset which is readily convertible at any time into cash. Can the

same be said of any other expenditure by the State ?"

With this transaction we may rest assured that the policy of State forest reservations has been irrevocably established in one of our States, thanks to the business-like propositions of its Governor. Another State, Pennsylvania, is moving in the same line, and the utterances of Governor Hastings before the Pennsylvania Forestry Association as reported in *Forest Leaves* for February show that the Executive of that State also is in hearty sympathy with the idea of creating State forest reserves.

Presently we expect Wisconsin and Minnesota to take up the case and recover possession of the cut-over lands to hold for future generations.

It is evident that under present economic conditions not much can be expected from private woodland owners, and the State is bound to act in anticipation of the demands of the future.

The proposition of the Governor of New York, to which we referred in our last issue—namely, to set aside an experimental forest area for the State of New York, has taken definite form by the introduction of a bill in Albany, providing that the Forest Preserve Board use part of the $500,000 to be devoted to additional purchases for the Adirondack Preserve to secure not to exceed 30,000 acres for such experiments. The title to this property is to be in the State and Cornell University jointly for twenty-five years, in order to make it possible for the Board of Trustees to conduct

"such experiments in forestry as it may deem advantageous to the interests of the State, and may plant, raise, cut and sell timber at such times, of such qualities and quantities and in such manner as it may deem best, with a view to obtaining and imparting knowledge concerning the scientific management and use of forests, their regulation and administration, the production, harvesting and reproduction of wood crops, and earning a revenue therefrom."

This cojoint ownership is necessary in order to permit all these things, since the curious limitation of the Constitution, which enjoins absolute inactivity in the Forest Preserve, would make them impossible for the State alone to undertake.

The plan is an excellent one, and it is hoped that the purchase and experiment will be as well executed as the work of the Forest Preserve Board has been so far.

To be sure the appropriation of $5,000 for Cornell University to execute the law will permit not much more than a preliminary forest survey, the gathering of the data for a working plan, and the preparation of such a plan.

Both the selection of the area and the preparation of the working plan should be made with the greatest circumspection, for such an undertaking, which contemplates a continuous management of a piece of property, finds its success in the proper start.

As we expressed ourselves before, the simultaneous establishment of a forestry school at Cornell and an organic relation of school and experiment forest would have appeared to us a superior arrangement. As it is we expect the school to follow soon as a logical consequence of the experiment.

The following resolution was adopted by the American Paper and Pulp Association at its annual meeting:

"*Resolved,* That the American Paper and Pulp Association believes that Con-

gress of the United States should provide a generous fund for the gathering of information, either immediately or in connection with the next census, in regard to the status of our forests; and further, that it believes that the various State governments should rigidly enforce all statutes now existing relating to the regulations and care of timberland, and should enact such further legislation as is necessary to insure ample protection from fire and other destructive elements; and

"*Resolved*, That it endorses the principles of forestry, and urges its members to study and apply the same to their holdings."

These "beliefs" are quite proper and orthodox, but in these cases faith will not save you. It will be necessary to instill the same beliefs into Congressmen and legislators, not by mere professions of faith, but by direct lobbying, as the Hon. Warner Miller, Chairman of the Forestry Committee of the Association, undoubtedly knows.

This would be lobbying of the right sort for the right things, for it concerns public as well as private interests.

The North Carolina State Forestry Association held its first annual meeting at Newbern. The main question discussed was that of securing protection against forest fires.

The meeting was adjourned to Wilmington, and there a hearing was given to the members before the Chamber of Commerce of that city, which was holding a fully attended annual meeting.

Prof. Holmes, of the State Geological Survey, Dr. Fernow, Dr. C. A. Schenck, of Biltmore, and Mr. D. M. Riordan, Vice President of the American Forestry Association, addressed the meeting, as a result of which a hearty co-operation of the Chamber was secured by the appointment of a committee to promote desirable legislation and other measures of relief from the fire fiend.

One new idea, at least, was developed during this meeting, the suggestion coming from one of the leading lumbermen of the city—namely, that the lumbermen and dealers in naval stores print on the back of their bills a brief admonition to their customers, who supply them with logs, etc., to keep fires out of young forest growth. It is expected that this will work as a useful educational measure by enlisting the people who make their living from the woods, in their protection.

The Colorado Forestry Association met in annual session at Denver, February 11. The principal interest of the session centered in the protection of the Forest Reserves in that State. Among the resolutions passed was one urging the use of the Army as a forest-reserve patrol, and the Association will use its best endeavors to accomplish such protection. Governor Adams was present and expressed himself as heartily in favor, both personally and officially, of the protection of the forest area of the State. A committee consisting of President W. N. Byers and four members was appointed to draft legislation for the protection of the forests of the State. Vice Presidents were elected for the several counties, and Mr. J. B. Thoburn, of Denver, was elected secretary.

It is with great pleasure that THE FORESTER acknowledges in this public manner receipt of a letter enclosing a paper read before The Farmers' Institute of Burt County, Nebraska, from Mr. Geo. W. Minier, of Minier, Ill., who now,

in his 85th year, is still actively preaching the gospel of rational forest and tree planting, which he began with and probably before the formation of the American Forestry Association, of which he is a charter member, once a President and now Vice President for his State.

Going into the treeless prairie in 1851 to make a farm and home, he began to practice before he preached, and his trees, set now nearly half a century ago, of ash and soft and sugar maple, walnut, butternut, tulip, coffee tree, with eight kinds of evergreens, are a better sermon than any words, showing the advantage to a prairie farm in shade, windbreak and general improved appearance, which comes from arboriculture, inviting imitation of the example.

We mourn in the death of Mr. J. O. Barrett, of Browns Valley, which occurred during the last month, one of the most active propagandists for forestry in the State of Minnesota. He was thoroughly imbued with the importance of the subject, and was a prolific writer in newspapers and journals. As secretary of the State Forestry Association, which receives support from the State treasury, he compiled the later editions of the *Treeplanters' Manual*, which was first conceived by Leonard Hodges, the pioneer forest planter of the West, and founder of the State Association in 1876. This manual is, perhaps, the most useful popular compilation on tree planting in the prairies.

THE FORESTER has a correspondent who wishes to dispose of a set of eight volumes, "Arboretum et Fruticetum Britannicum, by J. C. Loudon, 1838," in good order, at a price of $10.00, a very reasonable figure for this standard work of tree knowledge.

Wood-Pulp Supplies and Forestry.

Abstract of an address by *Dr. B. E. Fernow*, before the annual meeting of the American Paper and Pulp Association, February 16, 1898.

The discussion of forestry before an association of business men like the paper and pulp manufacturers, who have invested in their mills and plants over two hundred million dollars, producing annually over three million tons of material, worth over one hundred million dollars, means largely a discussion of the future of supplies for the wood-pulp and paper trade, for forestry is nothing more nor less than the securing of future supplies, the rational use of forests, the art of managing and reproducing wood crops. Such a discussion of the future, to be sure, can be of interest only to those who consider their business and their plants as a permanent and continuous investment and not as so many of our business enterprises, a mere speculation, which is undertaken in the hope that when the basis for the speculation is gone the enterprise will have netted not only a profit but also have reimbursed the outlay for mills and structures.

With the settling of the country, and as the rich resources have been exploited for their cream, and skim milk only is left, a more conservative business becomes necessary; the need of considering the future forces itself upon the more thoughtful; mobility becomes less profitable; stability and permanency, continuity of the basis of its own existence must be taken into account in carrying on business.

Development of Paper Pulp Industry in 15 Years.

Year.	Ground wood-pulp. Daily capacity, pounds. Thousands	Chemical fibre. Daily capacity, pounds. Thou ands	Wood required per annum Cords estimated. Thousands	Increase Per cent.	
				Bi-ennial	Total
1882...	560	360	213	..	..
1884...	842	576	332	55	55
1886...	1,026	587	367	10	72
1888...	1,620	617	476	29	123
1890...	3,030	1,112	876	84	311
1892...	3,587	1,736	1,177	34	452
1894...	5,074	2,526	1,688	43	692
1895...	6,001	3,418	2,154	27	911

Hence in the wood-pulp business the question of raw supplies becomes paramount.

The wood-pulp industry (as you are aware) is a development of recent times. Just a third of a century ago the first large pulp mill was established near Philadelphia, but the phenomenal growth of the industry began only within the last dozen years or so, during which the product has been doubled three times until now over one and a half million tons of pulp, two-thirds ground and one-third chemical pulp, is the annual output of the 1,200 mills, more or less, requiring not less than two million cords of wood.

While the growth of the industry will perhaps not continue at the same rate as in the past, there seems no good reason why it should not expand further and continuously, for in spite of the enormous increase in the use of wood-pulp, there is hardly yet 30 per cent of our paper consumption supplied by this material. At any rate we may for some time to come consider the consumption of two million cords of wood per year an exceedingly conservative figure upon which to base our considerations of the future suplies.

Where do these supplies come from? Although there are some broadleaf trees or so-called hardwoods used for pulp, especially Poplar, Birch and Maple, with little Beech, Basswood, Gum and Buckeye, the bulk of our wood-pulp is made from coniferous wood, and especially from Spruce, with Pine, Hemlock, Cypress, Fir and Tamarack in smaller quantities. That is to say, the bulk of the pulp is made from that class of timber which is also most heavily drawn upon for lumber supplies in general; for of our enormous lumber consumption of nearly 40 billion feet, B. M., at least two-thirds is coniferous material. Again, sixth-sevenths of the pulp product comes from the Northern States and relies, therefore, on the coniferous soft-woods, Spruce, White Pine and Hemlock; furthermore, at present, three-fourths of this product comes from the northeastern States, New England, New York and Pennsylvania.

Hence, for the present practical purposes, from the standpoint of the mill-owner, the supplies of this confined area would only need consideration. For it is unlikely that transportation of the bulky, raw material from any long distance to the mills will ever be practicable; the moving of the pulp mill to the bases of the supplies would probably suggest itself more readily.

What are then the supplies of these soft-wood conifers in the northeastern States?

The speaker then referred to the estimates given by him in Senate document No. 40, 55th Congress, which would show that hardly more than 10 to 20 years' supply of lumber and pulp-wood material may be found in the northeastern States, and that Canada could not contribute much to lengthen the time when a shortage must occur.

If there is a shortage in wheat crops or cotton crops, two remedies suggest themselves at once: Economy in their use, which comes about naturally by the increase in the price, and increase of the crop area the next year to make up the deficiency. The governor, the regulator of supply and demand, works automatically, rapidly and instantly. The same remedies suggest themselves also for meeting a deficiency in wood crops with the additional one of improvement in the machinery and processes of using the same. But there is one very essential difference in the two cases. The field crops mentioned are annual, the shortage needs to last only one season, is known readily and remedied readily.

Wood crops require many years to mature; the knowledge of even an approaching shortage is difficult to attain; the governor which in all other trades adjusts prices and thereby balances consumption and supplies on hand, works sluggishly in the case of wood crops, and only just before the danger point is fairly reached, does it indicate over-pressure.

Even now, you are but little concerned, and the general public, which is finally the party most hurt by such loss or short-

age of a valuable resource, sits in ignorance awaiting its fate helplessly.

I suggest, therefore, that it is your interest, as well as that of the public, and its representative, the Government, to supply this defect in your machine; secure sufficiently accurate knowledge of the condition of our varied timber resources and of their future promise. Such knowledge, I believe, will wake up our happy-go-lucky wood-working industries to a realization that their basis of supplies needs repair badly; that the glory of the times of bounty has passed and we will for a time have to live on scant rations.

When once we know how far our virgin woods are depleted and how short the remnant, we may at least conclude that it will be wise not to squander the remainder uselessly. This will bring us to the next step, namely, to protect forest property against fire. The few feeble half-hearted attempts at doing so in some of the States again exhibit our lack, as a community, of proper business sense and communal morality, for to protect life and property of its citizens is the first and primary function of communal life and government, and forest property has the same, nay, greater right to consideration in this respect, for it is property which cannot be restored except by many years of patient waiting. I would suggest that as a powerful association of men most directly interested in this class of property, you insist upon efficient execution of this function in each State in which you are located.

Then, when the first essential for the conduct of any permanent and stable business, *safety* has been secured, and the influence of civilization extends into the wild woods, we may apply the final remedy for our situation, forestry, the art of judicious management and reproduction of wood crops.

Just as the farmer sees to it that his field is fully stocked with useful plants, so the forester tries to have his land not only fully stocked, but fully stocked with the *right kind* of trees, useful and thrifty, keeping out or cutting out the runts and weeds, for there are weeds as well among trees as among other vegetation. He harvests his crop when it is most useful—*i. e*, when it pays best, considered from the standpoint of an investment, not a speculation; but at the same time, and here he differs from the mere logger, he secures a reproduction of the crop, for he proposes to stay in the business of growing wood crops: to hold on to his land as an investment.

This reproduction is by no means necessarily secured by planting, but it can be had merely by judicious cutting. The magnificent Spruce forests of Germany, which bear a burden of from 10,000 to 12,000 cubic feet when 100 years old, of which from 60,000 to 80,000 board feet is saw timber, with 250 to 350 trees to the acre, have mostly been secured not by the planting tool, but by natural re-seeding under the guidance of nature by skillful foresters.

There is the greatest misconception in this country as to what is implied in this word, "forestry," which 20 years ago was not even defined in our dictionaries, and of which even most of the enthusiastic friends who desired this art applied in the United States, had a curious notion.

Forestry is, with regard to wood crops, exactly what agriculture is to the production of food crops. At first the virgin soil responds without much trouble to the scratching of its surface, but by and by the soil is worked out and it requires some knowledge to make it bear a crop again; the necessity of increased food supply and mismanaged soil capital creates the farmer; just so when the virgin growth has been thoroughly exploited, the necessity of increased wood supply creates the forester. Just as the farmer knows how to get from the soil a larger product and correspondingly larger money return for his labor, intelligence and knowledge, so the forester knows how to get—by entirely different means, to be sure—a larger and better product and larger money return from his woodland.

The speaker then gave in detail statistics of various forest administrations,

to show the money result as well as the superior material result of forest management, notably in the Saxon forests, the details of which were contained in the last issue of THE FORESTER; the Bavarian results which appear on another page of this issue and the results of the Indian Forest administration, which will be given in a later issue.

Now look at your own forest areas! What do you get from them and what do you or can you expect from them after the virgin growth has been removed? What knowledge do you apply to manage this part of your most valuable property? What is its future? Who of you even knows what area you should have under management to supply your mill capacity?

You are cutting simply the accumulations of nature without any reference to what the future brings. You are cutting them to the smallest size that you think it will pay you to move out of the woods. Sometimes an uncertain feeling, that perhaps it pays better to leave the smaller trees, largely old runts, and come for them at a later time when they are bigger, prompts you to leave more, but I doubt whether any one of you has ever seriously considered that merely by properly regulating your cuttings you could, without curtailing your final harvest, reproduce a young crop and keep your property in ever improving, revenue-paying condition, by employing a trained forest manager. Management of forest property there is none.

Look at the manner in which our woods have been and are even now exploited. First comes the lumberman, who only sees white pine; he makes his roads, builds his shanties and mills. When he has cut out the best and his roads are grown up to wood and washed out, his shanties broken down, there comes another who only wants Tulip Poplar, Walnut, or Oak, or some other one kind, and he build new roads, new shanties, and so on, each one going to the expense of rigging up anew, each one creating a waste left in the woods, which might have answered some purpose other than his own. It is only lately that a division between the lumberman and pulpman is made here and there, the pulpman taking the inferior material and cutting the better logs to lumber. More such management at least is needed.

Just as the mining industry only thirty years ago was carried on in an empiric way, without scientific basis or direction, while now well educated assayers and superintendents are employed everywhere, so the time will come when every owner of a forest property will have learned that there is such a thing as forestry, which requires technical training, and which can increase the product and property of a forest area far beyond the unaided efforts of nature left to itself.

There is one point more I wish to bring out which is suggested by the remarks of one of your members. At the last annual meeting he used the following language:

"At no distant date, when the increased cost of wood to foreign mills reaches a point which it is certain to do soon, owing to the pronounced stand being taken in those countries against the indiscriminate cutting of wood (on account of its relation to the water supply and power of their rivers), we shall be able to cultivate a foreign trade in American pulp and fiber which shall be both permanent and profitable."

This is indeed mistaking the situation, and in the light of the above statements from Saxony, evidently an unfounded conjecture. While in this country people may well be alarmed by the enormous growth of the wood-pulp industry, which is slashing the forests even more closely, and hence, wastefully, as far as considerations of the future are concerned, than the lumber industry; in Germany the foresters welcome this industry with delight, for they now can sell to better advantage the inferior parts of the trees which formerly were good only for firewood, and still more advantageously they can dispose of the material that comes from the thinnings of the young growths, which from sylvicultural rea-

sons were highly desirable, but had often to be omitted because there was no sale for the material. It is the offal largely, which is given over to the pulp mill, the better parts being used for better purposes. Besides, Government control of private forestry has become less stringent, not more so.

No, gentlemen, whatever other factors may help you to find a foreign market, there is no hope to increase your exports on the supposition that the forest owners of Germany will spoil their well-established profitable business of wood-growing. The only hope is in managing the first end of your business, that upon which the whole existence of your mills is based, better than hitherto, and utilize the forces of nature and the greater fertility of your soil and climate, to outdo the German forester; in other words, by applying forestry.

The Sustained Yield of Spruce Lands.

[Abstract of an address before the American Paper and Pulp Association by GIFFORD PINCHOT.]

In the summer of 1897, at the instance of Dr. W. Seward Webb, an examination of Adirondack Spruce lands was made with a view of acquiring such a knowledge of the laws governing the growth of this tree that the main facts necessary for the conservative treatment of Spruce forest may be put within the reach of the men most likely to undertake it.

There are two qualities which enable the Spruce to maintain itself in fairly uniform proportion in the Adirondack forest. These are its ability to live under the heavy crowns of other trees, called tolerance of shade, and its remarkable power of reproduction. The latter depends first of all on the great quantities of seed which are produced year by year. The seeds of the Spruce are winged, and as they ripen and fall from the cones the winds catch and spread them widely throughout the forest. In this way the chance to take possession of suitable localities can be used whenever it arises. What these localities are is clearly indicated by the prevalence or absence of young growth. Thus it appears that Spruce seedlings germinate and grow easily on deep Spruce or Pine duff and on heavy beds of moss. Leaf mould seems less thoroughly adapted to their requirements, but they are found scattered in greater or less numbers almost throughout the forest. In small openings, especially those made by windfalls, they are most frequent, and here they occur in dense groups, growing rapidly under the influence of the light. In other still smaller openings in the forest such groups, of greater or less extent, are very common, and form one of the distinguishing features of the reproduction of this tree. In larger openings, caused by fire, the return of the Spruce to land from which it has been burned away is often slow. Commonly it is preceded by a growth of herbaceous plants or vines, followed by Poplar and Bird Cherry; and then, when a suitable seed bed has been prepared by the waste from these trees, the return of the Spruce itself takes place.

The fact that young seedlings are so widely distributed through the forest is due in part to the ability of this tree to grow under heavy shade. This does not mean that the Spruce will not flourish in the light, but merely that it is tolerant of the heavy cover which is a distinguishing character of the hardwood forest in the Adirondacks and throughout New England. The tolerance of the Spruce is not confined to early life, but persists far into middle age. Specimens from 100 to 150 years old, and less than 6 inches in diameter, are common. Such trees have survived on the little sunlight which could penetrate the heavy crowns above them, and, although not in vigorous health, are capable of continuing the struggle to an advanced age. (This ability to tolerate heavy shade is common to large numbers of forest trees, among which both the Beech and the hard Maple excel the Spruce with which they grow; but few trees possess the

wonderful capacity of the Spruce to recover from long years of suppression and grow almost or quite as vigorously and rapidly after it is ended as though all the conditions of life had been favorable from the beginning. It is to this capacity more than to any other, that the Spruce owes its presence in the Adirondack forests. Slow of growth in youth, and germinating, for the most part, under heavy shade, the Spruce could not survive in the hardwood forest where it reaches its best development, except by the combination of these two qualities, the ability to bear shade and the power to flourish when the suppression is over as vigorously as though it had never been.)

This power is not restricted to early life, but continues into old age as well. Thus at Ne-Ha-Sa-Ne several trees but 9 inches in diameter were found to have more than 200 annual rings on the stump, and of eighteen spruces with diameters ranging from 8.5 to 9.4 inches, but seven were younger than 150 years, and none were younger than 100. These trees had grown for years crowded and shaded by their more thrifty neighbors. Under such circumstances it is common to find small trees still alive, but with flattened and umbrella-shaped crowns. Even such trees are not beyond the possibility of usefulness. If the shade be removed they will usually begin to grow as vigorously as though they had never been suppressed. If the leading shoot has been killed, which is sometimes the case, a side branch will turn up and take its place, and the growth, although somewhat retarded by the accident, will go rapidly on. Such recuperation after shading not only takes place in small trees, but also in those which are from 15 to 20 feet in height, or even larger. A considerable proportion of all the large Spruce in the Adirondacks is found, on examination, to have passed through this stage. For example, on old windfalls in certain sections, and particularly Soft Maple flats, many of the old Spruces carry clusters of very numerous persistent branches growing close together at 10 or 15 feet above the ground. These branches mark a period when the crown was flattened and umbrella-shaped. The present size of the Spruces shows plainly how, when the old trees above them were blown down, they shot up and grew thriftily in spite of the severe circumstances of their youth. It is true that when trees have attained such a size before being set free the injury to the lumber is serious, for the persistent branches entail the loss of a certain amount of clear stuff. If, however, the tree is small when freed it may be covered over in time and lumber of good quality may be produced.

The effect of openings in the forest on vigorous and suppressed trees alike is then to give them more room for development, a larger and better apparatus of roots and leaves for the gathering and digestion of plant food, and so to increase their rate of growth in diameter and height.

The practice of thinning is based on this capacity for increased growth on the part of trees which have been more or less vigorously set free, or, in other words, on the part of the members of a piece of forest which has been thinned. The removal of a certain number of trees from over-crowded woods increases the final product, instead of decreasing it, and an additional intermediate product is obtained from the wood cut in thinning. In this way the total output of a piece of forest in final cuttings and thinnings together is far greater than it could be without sylvicultural attention.

The abundant reproduction of the Spruce and its ability to survive under heavy shade are the essential reasons why trees of every diameter are present throughout the forest. The relative number in the different diameter classes is of the first importance in forest management, because upon it depends primarily the number of trees which will be ready for the ax at any future time. Thus, a continuous yield is difficult or impossible without a complete series of age classes. Data have been collected which furnish a very complete study of the diameter

classes of the Adirondack Spruce. The average number of trees of each diameter down to two inches, as well as the average number of seedlings and saplings under two inches, but large enough to be seen at a glance, has been determined from surveys covering more than 1,000 acres in Ne-Ha-Sa-Ne Park. The average numbers for the whole area studied are given in the table:

Table Showing the Number of Spruce for Each Diameter, Total and Average, on 1,047 Acres at Ne-Ha-Sa-Ne Park.

Diameter in Inches.	Number of Spruce.	Average per Acre.
Under 2	163,781	156.3
2	23,223	22.2
3	21,148	20.2
4	19,783	18.9
5	14,599	13.1
6	12,811	12.3
7	10,167	9 7
8	8,387	8.0
9	7,083	6.8
10	6,692	6.4
11	5,242	5.0
12	4,642	4.4
13	3,785	3.6
14	5,229	3.1
15	2,679	2.6
16	1,990	1.9
17	1,655	1.6
18	1,132	1.1
19	721	.69
20	507	.48
21	326	.31
22	184	.18
23	114	.109
24	55	.043
25	35	.033
26	15	.014
27	12	.011
28	7	.....
29	0	.....
30	1	.....
31	2	.....
32	1	.....
34	1	.....

Total over 2 inches, 150,228.

From this table it appears that a regular diminishing gradation exists in the number of trees per acre as we pass from small diameters to large. It is upon this proportion that predictions as to the future yield of lands once cut over are based, and upon a correct interpretation of it depends, to a very considerable degree, the reliability of the figures that are given.

A prediction of the future stand of cut-over Spruce land cannot disregard, if it is to be reliable, the number of trees which will die between the cuttings. To ascertain this figure the dead Spruce were calipered on 843 acres. The result gives an average of about three dead trees per acre.

The table which is to give full details has not yet been prepared.

We have now glanced at the general character of the Spruce and at some of the main facts which influence its growth. The resultant of all these facts is well expressed in the average increase in diameter of trees growing naturally in the original forest, as shown in the following table:

Rate of Growth in Diameter for the Last Ten Years, from Measurements of 300 Trees at Ne-Ha-Sa-Ne Park.

On Trees in Diameter, Inches.	Mean Annual Growth, Diameter, Inches.	No. Years Required to Grow One Inch.
9	.1	10
10	.12	8
11	.14	7
12	.12	8
13	.13	8
14	.14	7
15	.11	9
16	.11	9
17	.11	9
18	.11	9
19	.12	8
20	.10	10
21	.11	9
22	.08	12
23	.10	10
24	.10	10
27	.14	7

This table is restricted to trees of approximately merchantable size, and its results are exceedingly interesting. They differ conspicuously from those given by the present writer in the report made for Dr. Webb and published in the report of the special committee of the Assembly,

whose chairman was Hon. Thomas A. Wagstaff. The rate of growth there was considerably more rapid than that which is now found to exist. This further study makes it evident that the estimate previously reached was too large.

How to Apply Forestry in Spruce Lands.*

[Abstract of an address before the American Paper and Pulp Association by AUSTIN CARY.]

I.

The wild lands with which I have more or less personal acquaintance are those of Maine and Northern New Hampshire. Of these the westerly ones, being nearer to market and covered with a heavier stand of timber, are the more valuable.

The stand of Spruce for this whole region ranges from 10,000 feet per acre, at the higher elevations (above 1,500 feet) in the New Hampshire mountains, to 5,000 feet per acre in the Moosehead Lake region (elevation 1,023 feet), and 3,000 feet or less per acre from the Penobscot to the St. John (elevation about 500 feet.)

Within the region of its distribution Spruce stands in a great variety of ways. Comparatively seldom does it stand in pure groves. Fir is almost universally associated with it, and the hardwoods of the region almost always enter to some gree into the mixture, especially on the best lands, where also the best Spruce occurs. Yellow Birch, with Beech and Maple, are the most common hardwoods. On poorer sites, the Beech and Maple are absent, and on exposed mountains the Yellow Birch is sometimes replaced by White Birch, which, with Spruce and Fir, is the hardiest species of the region.

There are stands which, though seldom pure, are mainly Spruce. These occur most frequently on steep mountain sides and on very rocky and poor-soiled flats. Sometimes the timber is thick and heavy; sometimes it is small, due to extreme exposure or bad drainage. Thick Spruce and Fir growths, in which the trees never reach a larger size than 12 or 14 inches on the stump, are of not infrequent occurrence. Throughout all varieties of stand, in which Spruce occurs, trees of every age and size are usually mixed together. The character of the mixture and the rate of growth are influenced by soil, by the lay of the land, by the kind of undergrowth and other considerations. Some of the trees growing in mixture are not only valueless in themselves, but as they are often in competition with the desirable Spruce, they are a detriment to the land. The big scraggy Yellow Birches are the most common example of this kind in our Spruce woods. They overshadow small growth, break off the tops of young Spruces, making them forked or stubbed, and seed freely. It would be proper forestry to kill these Birches, and the productive power of your lands would be increased by girdling them.

The virgin forests of New England, from the point of view of permanent Spruce production, really need to have cutting done upon them. Cutting is needed to save wood from decay, and to put the land in better growing order. Cutting will improve the natural condition of the land and increase the rate of its growth of timber.

In virgin forest are trees dead of old age and others past their prime, shrinking in quality every year. Such trees should be cut. Next come a proportion of poor trees, such as are diseased, deformed or that through dense and prolonged shading have lost their vitality. These may be of any size. They are not such as will grow in value and should be cut. Then there are the big trees oppressing the little ones. The big trees are heavily crowned—big for that very reason. As one tree overtops its neighbors its foliage thickens, its limbs lengthen and it may overshadow a whole patch of little ones a few feet high. If

*In order to do justice to this very practical paper, which, in very simple manner, attempts to teach first principles of sylviculture, it has been found necessary to preserve the original language as much as possible and to divide it into two parts, so as not to overcrowd the present issue.

we were cutting with a view to growth, we would take that big tree out, and if carefully done we should have ample stock to replace it. The young growth is not always sufficient to insure a stand; sometimes a big Spruce is isolated among hardwood. That fellow should be kept for seed supply. His retention is the main hope for the future of Spruce for rods around.

All of these ideas will be rendered clearer by record of the trees on a sample half acre, notes of which, collected in the woods, in the employ of members of this association, are appended. In the table on the opposite page, besides scoring the trees and commenting on their condition, the treatment in the way of cutting is noted, which we may say really needs to be done to put the land into best growing order. The half acre is a heavily timbered one from Northern New Hampshire. It possesses some 8,000 feet of Spruce, large and small, and the notes show that about 3,000 feet could be taken from the land in the shape of trees that are over-ripe, or else are impeding the growth of young timber. If these could be taken away, and in addition, due deference being paid to wind protection, about a dozen worthless Birches could be killed, the land would really be in much better growing condition.

The question next arises: To what extent does lumbering, as now practiced, carry out the purpose of forestry in preserving and promoting the growing power of the land ?

Woods Fit for Paper Pulp.

According to a canvass made by the United States Division of Forestry in 1888, nearly half of the 240 wood-pulp mills then reporting used nothing but Spruce, about 25 per cent used Spruce and Poplar, and only 6 per cent used Poplar alone. Of other woods some Pine was used in 21, Hemlock in 3, Basswood in 7, and a few used also Balsam, Cypress, and even Birch, Maple, Beech, Buckeye and Gum. Though the relation in the use of different woods has changed to a small extent, on the whole it remains true that the bulk of the wood pulp is made of Spruce, and small quantities only of Poplar and other woods.

Considering the rapid increase of the wood-pulp industry and the rapid reduction of Spruce supplies, the question naturally arises : What is there to substitute for Spruce ?

Before answering this, it may be well first to consider the qualities necessary to a good pulp wood, which at the same time explains, in part, why Spruce has thus far been preferred.

Whether used in the mechanical or chemical process, a good pulp wood should have a long fiber to insure strength and felting property, a light color to save work in bleaching, and, in addition, it should be soft to facilitate grinding or dissolving, and as free as possible from foreign matter, resin, coloring material, starch, etc.

Over 90 per cent of the wood substance of a piece of Spruce, Hemlock (and most of our Conifers) is made up of long, coarse fibers, known as tracheids, and less than 10 per cent is composed of the short cells forming the pith rays and lining the resin ducts or entering as separate resin cells, all of which are too short and practically valueless where length of fiber and felting quality are desired.

In a piece of so-called hardwood the case is entirely different. A piece of oak is composed largely (30-60 per cent) of very fine, hard, thick-walled fibers, not over one-fifth as long as those of Pine or Spruce, and the rest is partly formed of tracheids, broader with thinner walls, but not longer than the fibers,

Half Acre of Heavy Spruce Timber in Northern New Hampshire.

No.	Diameter Breast High. Inches.	Total Height. Feet.	Condition.	Treatment Recommended.
1	14.5	60	A fair tree	Cut. Frees Nos. 2 and 3.
2	10.5	40	Partly free	
3	8.5	50	Partly free	
4	9.5	45	Between two birches	Kill the birches.
5	7	30	Under birches	Kill the birches.
6	8	35	Under larger trees	
7	7	35	Under larger trees	
8	20	75	Grown tree; over others	Cut. Frees 6, 7, 9 and 10.
9	8	40	Thin crown; crowded	
10	10	50	Top in a birch	Kill the birch.
11	13.5	60	Partly free; growing	
12	10	50	Partly free; growing	Killing a birch will help.
13	14.5	55	Top in a birch	Kill the birch.
14	17	60	Top in same birch	Kill the birch. Cut this.
15	7	35	Under birches	Kill the birches.
16	21	80	Heavy crowned, but impedes none	
17	16.5	70	Thriving finely	Cut it. Frees 19 and several smaller.
18	25	80	Old, seamy tree	
19	7	35	Thin crowned, under	
20	17	75	Good, growing tree	
21	8	30	Under 20 and 22	
22	16.5	75	Fairly thrifty tree	
23	6.5	30	Thin; under others	
24	9	30	Stubbed	
25	9	50	Fairly thrifty	
26	8.5	45	Less thrifty	
27	14	65	Open, thriving tree	
28	20	80	Heavy crowned, grown tree	Cut. This helps 5 small trees.
29	6.5	30	Under others; thin	
30	6.5	30	Under others; thin	
31	10	50	Fairly thrifty tree	
32	16	70	Thrifty tree	
33	10	40	Free and fast growing	
34	11	45	Stubbed by a birch	
35	14	50	Stubbed by a birch	
36	7	35	Under a large spruce	Cutting will free.
37	6	40	Very thin crowned	
38	11	55	Fairly thrifty	
39	7	25	Under a birch	Kill the birch.
40	20	70	Grown tree; over others	Cut. Will free several.
41	8	40	Between 40 and 42	
42	20	80	Little impediment to others	
43	14	40	Stubbed by a birch	Cut. Helps several smaller.
44	9.5	55	Fairly thrifty	
45	11	55	Fairly thrifty	
46	9	45	Top in a big birch	Kill the birch.
47	10	45	Top in same birch	Kill the birch.
48	9	45	Fairly thrifty	Cutting others will help this.
49	10	50	Fairly thrifty	Cutting others will help this.
50	14	60	Thrifty tree	May be cut to free 4 smaller.
*	*	*	* * * * * * * *	* * * * * *

Summary of Spruce.

Saw-log trees over 12 inches on the stump, 36; about 7,000 feet B. M.
Pulp spruce (smaller, down to 6 inches breast diameter), 44; about 1,000 feet B. M.
Should be cut to aid growth, 10; about 3,000 feet B. M.
In addition there are on the area, between 3 and 6 inches breast diameter, 16 trees.
Smaller spruce (50 being in one bunch), 320 trees.

Other Species.

Of *Fir* there were on the ground 3 trees larger than 6 inches breast diameter, 11 between 3 and 6 inches and several hundred smaller.

Of *Maple*, 3 trees stood on the area and a bunch of small ones.

Birch, mainly white birch and entirely worthless, as follows:

Diameter.	Relations.
28 inches	Impedes 4 small spruce.
16 "	Shields 3 spruce of pulp size.
12 "	Impedes 3 little spruce.
12 "	Shields but 1 spruce.
17 "	Stubs 2 spruces, shields 2 others, also shades 2 patches of little spruce 1 foot or so high.
15 "	Impedes 2 spruce.
18 "	Impedes 5 spruce.
13 "	Impedes 1 spruce.

*The table, which in the original contains account of 80 Spruce, is not completed here since it is to serve only as a sample.

and over 25 per cent is made up of short cells, which in these woods not only form the pith rays, but also form a distinct tissue, the wood parenchyma, and are here, as in the case of Spruce and Pine, almost useless to the pulp manufacturer. In Poplar and other light and soft hardwoods the proportion of the hard fibers is smaller than in oak, but on the whole the same relations exist, the felting elements are smaller in size, less suited to pulp, and form a much smaller portion of the material than do the superior fibers of the Spruce, Pine and other Conifers. When treated in a chemical way, where the tissue is macerated by alkalis or acids, so that each cell or fiber becomes an independent element, these peculiarities of the structure of the wood fully assert themselves. More than 90 per cent is good fiber in a piece of Spruce or Pine, and less than 70 per cent is valuable in hardwood, and even this proportion is inferior in quality to the 90 per cent obtained in the use of Coniferous wood. In this process, too, the strands or bodies of hard fibers, characteristic of the hardwoods, particularly the heavier kinds, such as Oak, Beech and Maple, interfere materially with the process of dissolution. The thick walls and extremely small lumina or cavities of these fibers retard the penetration of the liquor, and the process requires more time, stronger solutions or higher pressures There is nothing in the wood of Spruce or Pine which affects this process to the same extent, for even the fibers of the ill-defined summer wood are much larger and their cavities proportionately wider.

When treated in the mechanical way of grinding to pulp the difference in the wood is less pronounced and the hardwoods make a better showing. Here the fibers and cells are not separated, the softer, coarser, thin-walled tissues are merely crushed and torn, parts of several cells cling together and form ragged shreds, so that even the vessels ("pores") of a piece of Poplar contribute to the felting material and appear in the pulp as long, flat fragments. Nevertheless even here the uniform large, thin walled fibers of the Conifers, behave far better than the small thick-walled elements of the hardwoods; for in cases like Beech and Maple these strands of fine hard fibers are extremely difficult to separate mechanically and the process involves not only much more work but also more or less loss of material.

Moreover, these strands, if incompletely separated, are liable to affect the product and introduce difficulty in its use.

A light color is desirable in all pulp wood, but it is much more important in the mechanical than in the chemical processes, since in the latter improvements may be expected which will greatly facilitate the work of bleaching. From a color standpoint the Poplars (Aspen, etc.) excel, but are closely followed by Spruce.

Besides these two really white kinds of wood there exist but few others, such as Tupelo Gum, and some Magnolias which have a really light color throughout, and might otherwise prove suitable. But while the heartwood even of White Pine may give trouble in bleaching there is little trouble to be feared from the sapwood of a number of Conifers as well as hardwoods, and in the future when pulp-wood will generally be sapling material, the present considerations of color will partly disappear.

Softness of wood is almost essential;

it facilitates the entrance of the "liquor" and consequently the dissolving in chemical processes, and it enables a more perfect shredding by mechanical means. In this respect Spruce excels, and nearly all Conifers, even the harder Pines, "open up" more readily than the heavier hardwoods. From these considerations it would appear that in chemical processes the Conifers of nearly all kinds, but particularly the softer White Pine, Hemlock, sapling material of Norway, Jack Pine, Loblolly, etc., may be expected to come into general use, while the hardwoods will be employed only where good color, softness and cheapness make them especially acceptable.

For ground pulp on the other hand, both the softer and whiter Conifers and hardwoods will be employed, while the harder, more resinous Conifers, and still more, the darker and heavier hardwoods are not likely to find favor.

What changes the future will bring in the proportion of mechanical and chemical pulp production cannot yet be foretold; the present claim that the chemical pulp factories would in general not prove successful are contradicted by a large number of cases, and the likelihood is that the failures were not alone due to the nature of the process. In view of these facts, it is probable that both processes will continue side by side for some time to come.

From the standpoint of supply, it is also quite probable that the Conifers will be in the future, as they have been in the past, the main pulp woods of our country. They are still quite abundant, and any step toward protection and reforestation such as may naturally be expected in the near future, will insure new supplies by the time the present stands are cut.

In the New England States and the East generally Spruce will probably continue, aided by Hemlock and possibly by second-growth Pine. In the Lake region, Hemlock, together with the scattering Spruce and Balsam, will be the pulp wood for years, and when exhausted, the young growth of the future Pine forests may be expected to take their place. The use of Jack Pine and Tamarack for chemical pulp naturally suggests itself in this connection. Of hardwoods only the Basswood would appear sufficiently abundant to warrant its consideration as a source of long-time supply, for the Aspen (Poplar), though very abundant numerically, is not thrifty, and it will depend on its sylvicultural treatment whether this tree will ever amount to more than a scrub-woods cover of the bare lands.

In the South coniferous material is found in the Spruce, White Pine and Hemlock of the mountains, and still more in the vast bodies of resinous hard Pines (Loblolly, Shortleaf, Longleaf, etc.). These pines cover large areas, not well suited to agriculture, and, if properly treated, are capable of furnishing for many years enormous quantities of pulp wood besides valuable saw timber, so that when the chemical processes are adapted to the use of this resinous hard Pine, the South is in position to support a great number of pulp mills.

The Western United States, with their enormous water-powers and extensive forests of Conifers are in good position to supply large quantities of pulp, but the several kinds of Spruce, Fir, Pine, etc., have not been sufficiently studied to warrant any detailed statements.

FILIBERT ROTH.

Financial Results of Forest Administration

II. Bavaria.

In this small kingdom, with over 5 million people on an area of about 29,000 square miles or about half as great as that of the State of Wisconsin and with about 40 per cent mountain district, the forest has long been recognized as an indispensable part of a well-to-do commonwealth. Even during the Middle Ages the cities and churches of this region accumulated forest properties, the "Nuremberger Reichswald" had become famous, and as early as the year 1616 definite forestry regulations helped to develop a judicious use of the woods and their maintenance on all exposed mountain lands.

For over 40 years the forests of Bavaria have covered in the neighborhood of 6 million acres or about 34 per cent of the total area, and they have been owned all this time in about the same proportions, namely, about one-third by the State, one-half by private owners and the rest by villages and other corporations.

The policy of the State has been, during all this time, to increase its holdings wherever practicable, and more than 8 million dollars have been spent in way of land purchases since 1830. But, even with private owners, a similar disposition exists, and though the right to clear land is given wherever this may be shown to be fit for agricultural purposes, there has been almost as much land restocked with woods by private owners and villages as has been cleared, so that the total holdings of private owners have not been reduced through clearing by more than one-third per mill. Of the 6.2 million acres of forest, about 46 per cent is stocked with Spruce and Fir, usually harvested at an age of about 120 years; 30 per cent is pine (nearly all "Scotch" pine—a hard pine resembling our Red or Norway pine) largely used as a fire-wood and generally cut at an age of 80 years and less. The rest is stocked with hardwoods, mostly Beech, which is allowed to grow to an age of about 120; some White Oak, part of which is managed as tanbark coppice, being cut down every 15–25 years, and part is allowed to grow into large timber, for which about 180 years are necessary in this region.

The yield or cut per acre is generally large. Groves one hundred years old, cutting 10,000 cubic feet of timber per acre, are by no means rare in the forests of the foothills, and even the poor rocky Alpine ranges are made to yield during the same length of time 3,000–4,000 cubic feet. In the State forests about 61 cubic feet per acre grows, on an average, every year over the entire area, so that they furnish an annual cut of about 120,000,000 cubic feet of timber and firewood.

In the private forests the growth and consequent yield is generally smaller, since less care is had and less skill displayed. Nevertheless, according to a thorough examination made about 1860, the growth even in these private and village woods amounted to about 54 cubic feet per acre and year.

With increased care the State forests, of which not over 5 per cent is unproductive as rocky wastes, roads, etc., have been made to yield more wood and a greater money return. Thus:

In 1829 the cut was 35 cubic feet of wood over 5 inch; in 1850 the cut was 44 cubic feet over 5 inch; in 1860 the cut was 48 cubic feet over 5 inch; and in 1896, the cut per acre had increased to 60 cubic feet. While in 1850 fully 84 per cent of the

cut was still firewood, this inferior class formed only 67 per cent in 1880, and this proportion is still changing in favor of bolt-size material, as the average age and size of the timber increases, being nearly half and half in 1896.

The money returns of Bavarian State forests have not been as great as those of the forests of Saxony and Wurtemberg. This is partly due to a prevalence of mountain lands which reduce the yield, increase the cost of all operations, and partly also to a less intensive management. Nevertheless improvements in methods have led to fully as great an advance in the net revenue here as in the neighboring States, so that the net income, which was only $1 per acre and year in 1850, is now $1.92, or nearly double that amount.

In this way the little State of Bavaria has a net income from its forest property alone—2,091,930 acres—of nearly four million dollars per year, after paying out in wages for supervision, logging, planting, etc., a like amount, the net revenue representing in 1896 just 50 per cent of the gross income.

Considering the many difficulties of stocking rough Alpine and other mountain lands with forests, it is noteworthy that of the total expenses only 8 per cent, or about 10 cents per acre and year, is devoted to that sylvicultural part of the work—*i. e.*, to planting, sowing, gathering seed, nursery work, etc., while 50 per cent is paid out for supervision and 30 per cent for cutting and logging.

It is also of interest in this connection to note that it was not by a short-sighted, stingy policy of retrenchment in expenses, but by a liberal policy that the forests have been made to furnish a steady and cheap supply of timber to hundreds of mills, cheap firewood to the whole people, and a net income, which, if regarded as an interest on the value of the forest property, makes this, at the prevailing 3 per cent rate, worth one hundred and thirty million dollars, or sixty-five dollars per acre, for land which without the forest cover would hardly bring ten dollars even in these densely settled countries.

Instead of expending only eighty cents per acre and year, as was done as late as 1860, Bavaria now expends more than double this amount, pays higher salaries, and maintains a larger force of steady workers; it spends about a quarter of a million per year on roads and other permanent improvements, and at the same time improves its woods, has more standing timber of larger average size, has more wood growing, and receives more money from this resource than ever before.

Book Notices.

[It was hoped that THE FORESTER would bring every month references to the contents and short reviews of all publications having a bearing on forestry, park management and allied subjects. Hitherto our space has been so limited and other matter of importance has required so much of it that this department had to be curtailed. We expect to be able to do better justice to it in our future issues.]

The last issue of *Forest Leaves* (February), which appeared in February, contains a list of the officers of the Pennsylvania Forestry Association for 1898; an address by Governor D. H. Hastings, of Pennsylvania, on Forestry Legislation in Pennsylvania; an extract from the annual message of Governor Black to the New York Legislature; a report of the annual meeting of the New Jersey Forestry Association, with articles on The Most Desirable Trees for Street and Lawn Planting in Chicago, by O. S. Whitmore; Eastern and Western Mountain Forests by C. A. Keffer, and a beautifully illustrated description of the Pin Oak by Dr. J. F. Rothrock. An article on the Banyan tree is copied from Z. A. Ragozin's Story of Vedic India.

The *Northwestern Lumberman's* trade review for 1897 appears in the issue of January 22. This annual publication of statistics is reliable and comprehensive, dealing especially with the White Pine, Hemlock and hardwood cut of the Northern States.

The February number of the *Canada Lumberman* (Toronto) gives a comprehensive review of the lumber trade of Canada for 1897.

Answers to Correspondents.

What is the difference between "dry rot" and "wet rot"? Is wet rot a fungus or oxydization?

Both "dry rot" and "wet rot" are produced by fungi of various species. It is still an open question whether the two exhibitions of "dry" and "wet" rot are not due to the same fungi. According to Hartig, the main difference in the conditions producing the two different kinds of rot seems to lie in the fact that the fungi producing "dry rot" require that the wood attacked be wet or moist and be constantly kept so; while the "wet rot" fungi, among which *Merulius lacrymans* is the most prominent, are capable of destroying comparatively dry wood, having the capacity of attracting moisture from the atmosphere and also of changing the wood in its aggregate so as to establish capillary action, by which it attracts moisture from the surroundings. It appears that the spores of the latter fungi germinate more freely in the presence of alkalies, which may account for their occurrence in sea water.

What especial treatment do nut trees require to make them fruitful?

One is apt to imagine because Chestnut, Hickory, Pecan, Walnut and Butternut grow naturally in mixed forest, that the conditions there prevailing are best adapted to the species, and this is doubtless true, if production of timber alone is considered. But if the fruit—the nut crop—is of more importance than the timber, forest conditions are about the worst the tree could be grown in. The nut is as much the fruit of the Hickory as is the apple the fruit of the apple tree on which it grows, and no one would think of setting an apple orchard so close as to prevent crown development.

In nut culture the greatest possible development of crown should be obtained, and to this end the trees should have plenty of space, and the pruning should have in view a free circulation of air with plenty of light in all parts of the top. In this way every branch will produce the greatest possible number of fruiting spurs.

It should be remembered that the fruit of nut trees, as with all other fruit crops, is a constant drain on the fertility of the soil. Grown in close forest, nut trees, in common with all others, make but slight demands on the fertility of the soil, since they return to it in their annual fall of leaves, much the greater part of the soil elements which they have used in growth. But when the trees stand wide apart and the full crop of nuts is removed, the question of fertilizing becomes quite as important as in any other kind of orchard culture. The essential points in nut culture, then, are attention to soil fertility and full development of crown; in other words, the same attention and methods as in any other orchard.

Is it desirable to apply lime to ground on which trees are to be grown?

So far as lime has the capacity of making the soil more porous and of opening up mineral constituents that are inert, its action on tree growth must be as beneficial as on other crops. The action to be sure can only be of short duration compared with the long life of trees.

The Rhode Island Experiment Station began in 1893 a comprehensive inquiry into the effect of lime upon many kinds of plants when applied to the soil as a manure. Five thousand four hundred lbs. air-slacked lime were applied per acre in 1893, and 1,000 lbs. in 1894. Other fertilizers were applied in equal amounts to the several plats, two of which were limed and two were left without lime. Among the great variety of plants which have thus far been under observation in this experiment a record is given in the Annual Report of the Station for 1896 of the action on American White Birch, White Elm and Sugar Maple. It would seem that of these species the Elm is much benefited by the application of lime to the soil (all the trees being nursery size), and the others were but little affected. The record only covers the growth of a single year; hence but little generalization is as yet permissible.